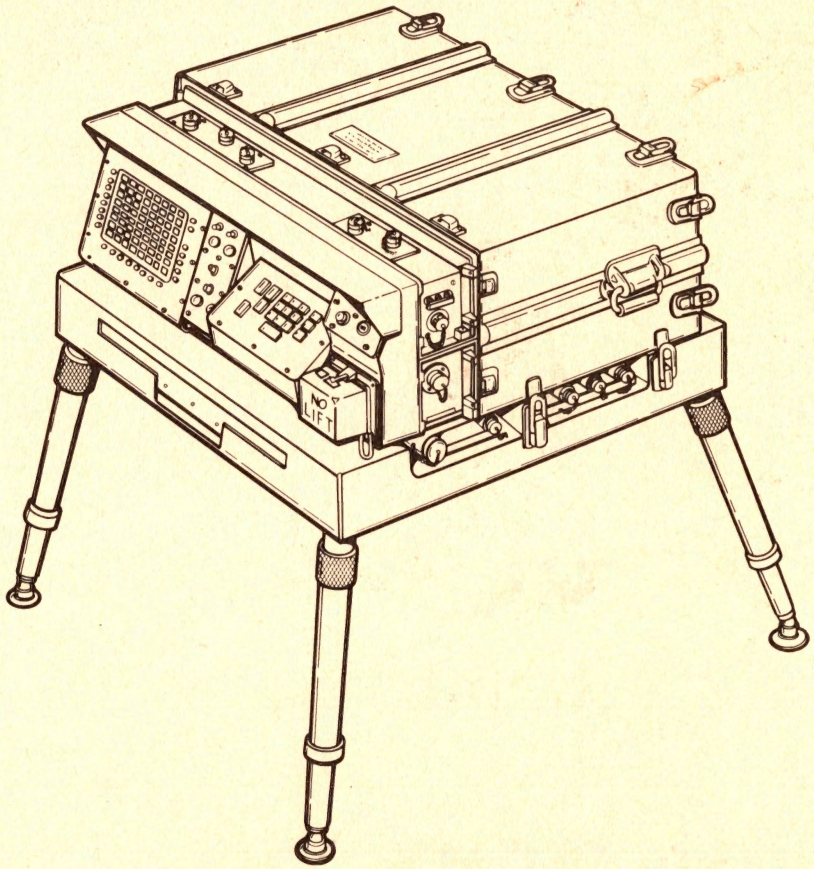
TM 9-1220-221-34/8

TECHNICAL MANUAL

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL





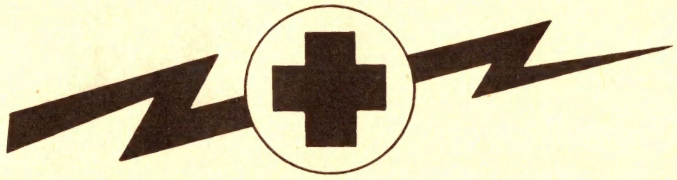

# AUTHORIZED TAPE ROUTINES FOR

# COMPUTER, GUN DIRECTION, M18 (FADAC) 1220-00-448-0131

HEADQUARTERS, DEPARTMENT OF THE ARMY

JUNE 1981

**WARNING**



HIGH VOLTAGE

is used in the operation of this equipment.

DEATH ON CONTACT

may result if personnel fail to observe safety precautions.

Never work on electronic equipment unless there is another person nearby who is familiar with the operation and hazards of the equipment and who is competent in administering first aid. When the techni-cian is aided by operators, he must warn them about dangerous areas.

Whenever possible, the power supply to the equipment must be shut off before beginning work on the equipment. Take particular care to ground every capacitor likely to hold a dangerous potential. When working inside the equipment after the power has been turned off, always ground every part before touching it.

Be careful not to contact high-voltage connections of 220-volt ac input connections when installing or operating this equipment.

Whenever the nature of the operation permits, keep one hand away from the equipment to reduce the hazard of current flowing through vital organs of the body.

Do not be misled by the term "low voltage". Potentials as low as 50 volts may cause death.

For artificial respiration, refer to FM 21-11.

Technical Manual
No. 9-1220-221-34/8

HEADQUARTERS,
DEPARTMENT OF THE ARMY
Washington DC, *1 June 1981*

# DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

# AUTHORIZED TAPE ROUTINES

# FOR

# COMPUTER, GUN DIRECTION, M18

# (FADAC) 1220-00-448-0131

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms, or DA Form 2028-2 located in the back of this manual direct to: Commander, US Army Armament Materiel Readiness Command, ATTN: DRSAR-MAS, Rock Island, IL 61299. A reply will be furnished to you.

Page



*This manual supersedes TM 9-1220-221-34/8, 11 May 1973.

List of Tables

# CHAPTER 1
# INTRODUCTION

## Section I. GENERAL

### 1-1. SCOPE

a. **This technical manual is published for information and guidance of personnel responsible for direct support and general support maintenance of gun direction computer M18 (FADAC). The instructions supplement TM 9-1220-221-34/1, provides the functional description of all authorized diagnostic tape routines. Additional information provides procedures for loading, verifying tape routines, and test procedures. The instructions in this manual are intended for maintenance specialists who have been thoroughly trained in electronic maintenance practices and have had previous experience in performance testing and adjustment procedures on similar types of equipment. This manual does not contain information which is intended primarily for the using organization, since such information is available to maintenance personnel in the pertinent operator and organizational maintenance manual.**

b. For a general description of the FADAC and its operation and maintenance, refer to TM 9-1220-221-10-1, TM 9-1220-221-10-2, TM 9-1220-221-20&P, and the other volumes of the TM 9-1220-221-34 series. TM 9-1220-221-34/1 contains a list of current references, including supply and technical manuals and other available publications applicable to the FADAC, its associated and support equipment and kits.

c. The appendix of this manual contains a list of current references, including supply and technical manuals, forms, and other available publications that are applicable.

### 1-2. MAINTENANCE FORMS, RECORDS, AND REPORTS

a. Authorized Forms. Refer to TM 38-750. For listing of all forms, refer to DA Pam 310-2.

b. Report of Accidents. The reports necessary to comply with the requirements of the Army safety program are prescribed in detail in AR 385-40.

c. Reporting Equipment Improvement Recommendations (EIR's). If your computer needs improvement, let us know. Send us an EIR. You, the user, are the only one who can tell us what you don't like about your equipment. Let us know why you don't like the design. Tell us why a procedure is hard to perform. Put it on an SF 368 (Quality Deficiency Report). Mail it to Commander, US Army Armament Materiel Readiness Command, ATTN: DRSAR-MAO, Rock Island, IL 61299. We'll send you a reply.

### 1-3. FIELD MAINTENANCE ALLOCATION

**Direct and general support maintenance responsibilities prescribed in this technical manual will apply as reflected in the allocation of maintenance parts and tools listed in TM 9-1220-221-34P.**

# Section II. DESCRIPTION OF TAPE ROUTINES

## 1-4. GENERAL

The diagnostic programs are to be used after having performed a FALT test of the FADAC, and the FADAC is not operational after this test. The diagnostic programs have a special use since they enhance the technician's capability for locating intermittent problems due to marginal components in the FADAC.

## 1-5. CIRCUITS EXERCISED DURING TEST

Each diagnostic tape programs the FADAC to exercise a different group of circuit boards, thereby localizing trouble to a relatively small group of circuit boards in the FADAC. The ten diagnostic programs are listed in table 1-1 and further described in this paragraph.

a. Clear Memory (Unclassified and All Data). This program is not a diagnostic program as such, but it is to be used prior to the filling of the FADAC with a ballistic program or a diagnostic program.

b. Memory Evaluation. This program is to be used as a dynamic test of the FADAC memory unit, and all circuitry associated with the memory. This program is especially useful in locating and continually testing a questionable memory or write head, or a questionable read or write circuit board.

c. Loop Test. This program is to be used in testing the A, L, and N registers and the R, Q, and D loops.

d. Nixie Display. This program is to be used in determining the ability of the nixies to display each numeral or symbol; the battery nixies are not tested by this program.

e. Control Panel. This program is to be used in testing the keyboard unit, the matrix unit, and the set up switches located on the front panel of the FADAC.

f. Teletype Output. This program is to be used in conjunction with the TT-537 or equivalent teletypewriter. The program will allow testing of the FADAC teletypewriter output circuits and the teletypewriter itself.

g. Clear Hot Storage (Cannon), Rocket. This routine is under program control of the FADAC and may only be used with the cannon programs. For rocket programs, a different tape routine (8213315-46) must be used. This tape routine, operated without the SDR, is used to return a selected memory channel of working storage to the state it was in after the program was entered by an SDR.

h. Mechanical Reader. The tape contains three separate routines and is used to dynamically test the mechanical reader on FADAC. The FADAC must be loaded with either a cannon or rocket program before this routine can be used. Use of this routine is mandatory prior to replacement of the reader.

i. Repetitive Test. Used as a confidence test after completion of repairs. A standard ballistic program is repeated and monitored. The FADAC must be reprogrammed after this routine.

Table 1-1. Authorized Tape Routines

NOTE

Excluding clear hot storage (rocket), all other tapes in table 1-1 are part of cartridge assembly (8213330-26). The clear hot storage (rocket) must be ordered separately under 8213315-46.

| Page No. | Paragraph no. | Part no. | Title |
|---|---|---|---|
| 2-6 | 2-7 | 8213315-27A | Clear Memory (unclassified data only) |
| 2-7 | 2-8 | 8213315-30 | Clear Memory tape (all data) |
| 2-8 | 2-9 | 8213315-28A | Memory Evaluation Routine |
| 2-11 | 2-10 | 8213315-31A | Loop Test Routine |
| 2-13 | 2-11 | 8213315-33 | Nixie Display Routine |
| 2-13 | 2-12 | 8213315-32 | Control Panel Routine |
| 2-16 | 2-13 | 8213315-29A | Teletype Output Routine |
| 2-17 | 2-14 | 8213315-26A | Clear Hot Storage Routine |
| 2-17 | 2-14 | 8213315-44 | Clear Hot Storage Routine |
| 2-17 | 2-14 | 8213315-46 | Clear Hot Storage (Rockets) |
| 2-17 | 2-14 | 8213836-96 | Clear Hot Storage tape |
| 2-18 | 2-15 | 8213836-98 | Mechanical Reader Diagnostic Routine |
| 2-18 | 2-15 | 8213315-116 | Mechanical Reader Diagnostic Routine |
| 2-21 | 2-16 | 8213315-34C | Repetitive Test Routine* |
| 2-21 | 2-16 | 8213836-97 | Repetitive Test Routine* |
| 2-21 | 2-16 | 8213315-117 | Repetitive Test Routine* |

*The routine dash number will change, depending upon the most current field program in use.

CHAPTER 2

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

## Section I. TAPE DATA

### 2-1. GENERAL

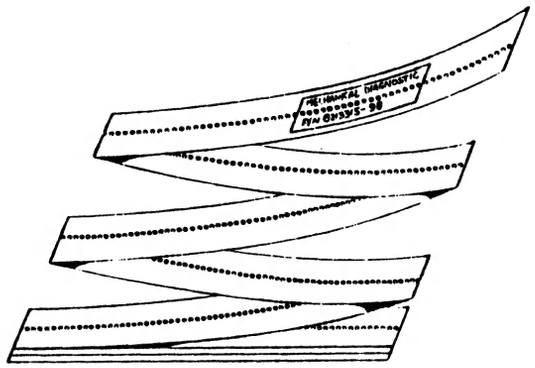
a. Logic test tapes B, C, D, and E (TM 9-1220-221-34/2, TM 9-1220-221-34/3, TM 9-1220-221-34/4, and TM 9-1220-221-34/5 respectively) are used to statically test the FADAC, therefore there is very little probability of isolating trouble or an intermittent condition of operation. The diagnostic test tapes may then be used to extend the coverage of testing the FADAC in this area of intermittents.

b. The diagnostic test tapes may be used individually or collectively to dynamically test specific circuits for intermittent mechanical conditions such as loose connections, poor soldering, frayed wires, etc.

c. If a specific problem, such as a parity inclination on reading memory information was suspected (where the logic test tapes could not detect the malfunction) the memory evaluation test tape would then be utilized. Or, if attempts to program the FADAC have failed, the loop test tape routine can be used to either isolate or eliminate the registers as a possible source of trouble.

### 2-2. DIAGNOSTIC TEST TAPES

a. The diagnostic tape routines presently authorized for use with FADAC are listed in table 1-1 (p 1-3). The perforated tapes are generally black opaque material that is moisture proof and static free. The tape is accordion folded at 9 inches in the fiber container supplied; tape length is dependent upon function and purpose of the test. Refer to the illustration on page 2-1.



b. Long duration program tapes are entered into the FADAC through a tape reader, such as the signal data reproducer AN/GSQ-64 (SDR). The SDR has the capability of reading both the teletype (five level type) or field (eight level type) at approximately 500 characters (lines) per second. Diagnostic test tape routines may also be entered through the FADAC's mechanical tape reader.

c. The mechanical tape reader of the FADAC is generally used to enter the test tape routines. The speed is limited to 10 characters per second. Information entered into the FADAC memory unit from an input device (either SDR or mechanical reader) is usually in the octal input format.

d. The diagnostic tape routines are usually used after incorrect or questionable results have been obtained when using the FALT test tapes to dynamically test complete circuits in the FADAC. The FALT test tapes perform static tests of individual inputs and outputs of logic gate circuits. The diagnostic tapes, however, will evaluate, test, and recycle test routines within a desired area of the FADAC. If there is doubt about the proper operation of any unit (or an intermittent is suspected) such as the keyboard nixie display, or memory storage unit, etc, the technician then has an additional troubleshooting aid to assist in determining the affected area and isolating the trouble. It is then a matter of further isolating the problem to the circuit board, connector pins, or defective wiring responsible for the trouble.

e. In most cases, a list of suspected boards is provided with the test tape. Therefore, test results indicate an error condition may be further investigated by checking the associated boards. The above trouble isolation techniques require an overall working knowledge of the FADAC and its digital data processing techniques. For further information, refer to the appendix for a list of current references.

## 2-3. PAPER TAPE FORMAT

a. All routines entering the FADAC through the mechanical reader SDR are on punched paper tape. The FADAC accepts input information in either of two codes; eight level field data code or five level teletype code.

b. Each octal character on tape is composed of five binary digits arranged in horizontal rows perpendicular to the length of the tape. The presence of a hole in the tape represents a logic 1 and the absence of a hole represents logic Ø. A character corresponds to an octal digit. Commands require only one character, however, instruction words require 11 characters and location in memory (channel-sector) requires five characters. The five level and eight level tapes have the same format; however, they differ in the character makeup of five binary digits and eight binary digits respectively. The computer is usually in the octal input mode when information is entered from the mechanical reader or the SDR. It recognizes only 16 octal characters; eight characters represent the numbers 0 thru 7, and the remaining eight characters represent control commands (verify, locate, enter, etc). All characters in this octal code are shown in TM 9-1220-221-34/1.

c. The first character on the tape is the verify code. By changing the state of the MC flip-flop it tells the computer to compare the information that follows with the information already in memory to verify its accuracy. It verifies that the routines loaded into memory were read and entered correctly.

d. As described above, the information must already be in memory before the verify code can be used. The front panel ERROR indicator is associated with this function. If the test routine information is in memory but the tape does not verify, the tape will stop and the ERROR indicator will flash. Therefore, when entering a routine, the tape must be loaded in the mechanical reader or SDR so that the verify code on the tape is not read. After entering a routine, it should be verified by entering again; however, this time care should be taken to make sure that the verify code is read first.

NOTE

On the program printout the verify code is a minus sign (-).

e. As shown in the illustration on page 2-3 , following the verify code there is a blank area of several inches with sprocket holes only and no character information. The next five octal characters contain the starting memory address, the location where the first instruction word is stored.

f. The single character locate code follows the five-character starting address. When the locate code is read, the five preceding address characters are shifted into the L loop. This functions as the location counter assigns information from the tape to memory locations.

NOTE

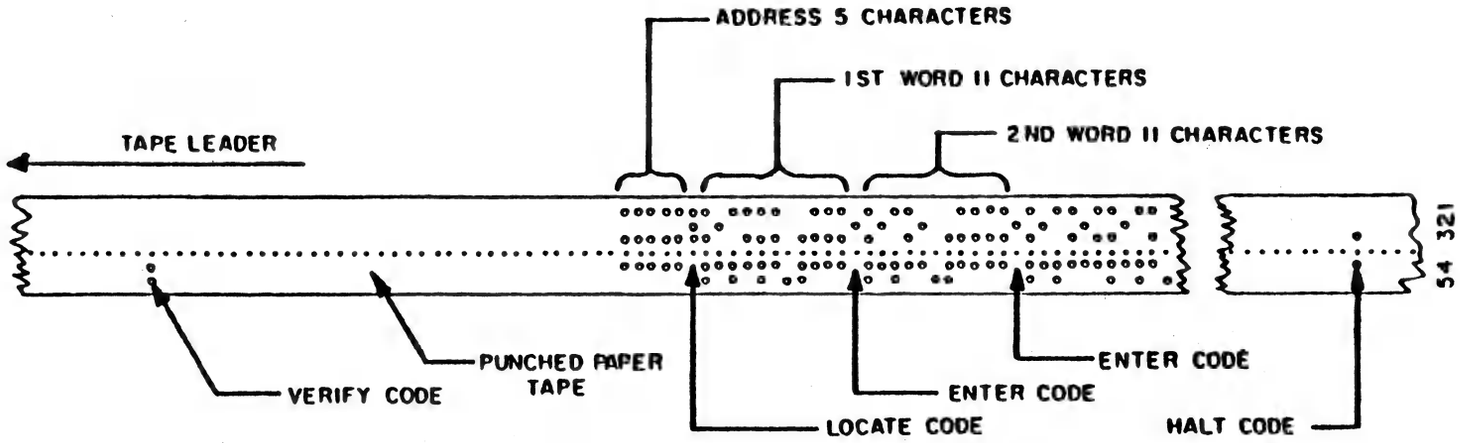
On program printouts, the locate code is a decimal point (.).

g. The next 11 octal characters make up the first instruction word; the single-character enter code follows. When the enter code is read, the instruction word goes into storage at the address held in the location counter. The enter code then updates the location counter by one number for storage of the next instruction word. Information entering the FADAC will be sequentially loaded into memory until a new address followed by the locate code is read from the tape.

NOTE

On program printouts, the enter code is the carriage return.

h. After loading the final word into memory, a single-character halt code is read. This changes the FADAC from input/output mode to the halt mode and stops the mechanical reader or SDR. The routine is then loaded into memory. To verify the accuracy of the information loaded into memory the tape is run once more. This time the SDR is allowed to read the verify code first.



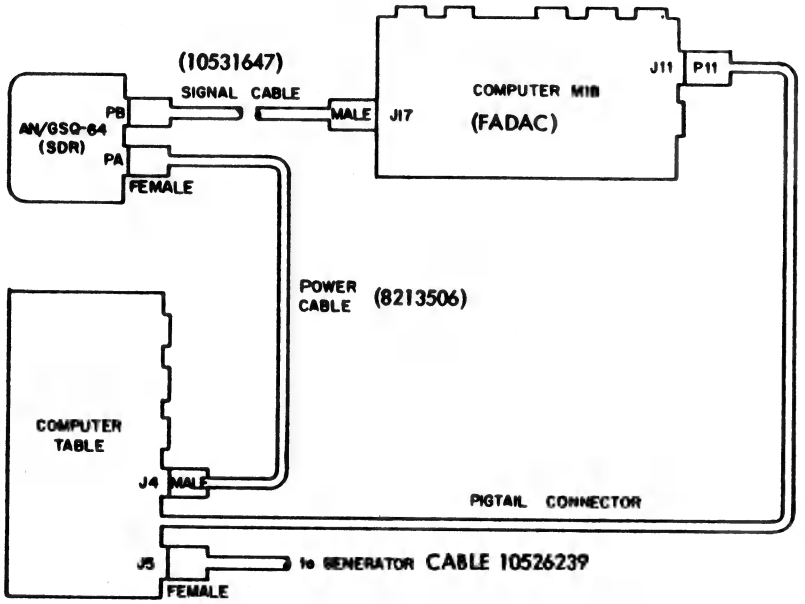
## Section II. PRELIMINARY SETUP

### 2-4. MECHANICAL READER AND SDR

a. The cable connections are as follows:

(1) Connect signal cable from P13 plug on front of SDR to J17 on the left side of the FADAC.

(2) Connect power on front of SDR to field table.




b. Set SDR switches as follows:

(1) AUXILIARY MEMORY switch in OFF position.

(2) TAPE ADVANCE switch in OFF position.

(3) FIELD DATA/TELETYPE switch.

(a) FIELD DATA position for eight level tape.

(b) TELETYPE position for five level tape.

(4) FILL-VERIFY switch in VERIFY position.

(5) COMPUTE switch in HALT position.

(6) CIRCUIT BREAKER in ON position.

(7) SIGNAL switch in ON position.

c. Set FADAC switches as follows:

(1) MARGINAL TEST switch in the OFF position.

(2) Circuit breaker in the ON position.

(3) ON/OFF switch in the ON position.

NOTE

The POWER READY indicator will light approximately 20 seconds after the POWER switch is turned on.

## 2-5. TAPE LOADING PROCEDURES

Perform FADAC and SDR procedures outlined in paragraph 2-4, then proceed as directed.

### ENTERING TEST ROUTINES THROUGH MECHANICAL READER

1 Insert tape into mechanical reader, ensure that the three-hole side of the tape (from edge of tape to small sprocket holes) is toward rear faceplate of the mechanical reader.

2 Ensure that the verify code on the leader of the tape is located to the right of the hole-sensing pins.

3 Depress the RESET button, then actuate the RECALL key on the FADAC keyboard.

4 Depress the START FADAC button on the SDR. The IN-OUT indicator should light and the tape commence to be read by the mechanical reader.

5 After the tape halts, repeat steps 1 thru 4.

NOTE

In step 2 ensure that the verify code on the tape leader is to the left of the hole-sensing pins. This will verify that the routine has been entered properly into FADAC by the mechanical reader.

### ENTERING TEST ROUTINES THROUGH THE SDR

1 Insert tape into SDR, ensure that the three hole side of the tape (from edge of tape to small sprocket holes) is toward the rear faceplate of the SDR.

2 Ensure that the verify code on the leader of the tape is below the light-sensing photodiodes of the SDR.

3 Depress the RESET button on the FADAC control panel.

4 Depress the START FADAC button on the SDR.

5 The IN-OUT indicator on the control panel should light and the tape commence to be read by the SDR.

6 After the tape halts, repeat steps 1 and 3 thru 5. Verify light on SDR will light.

NOTE

In step 2 ensure that the verify code on the tape leader is to the left of the light-sensing photodiodes of the SDR. This will verify that the routine has been entered properly into the FADAC by the SDR.

## Section III. DIAGNOSTIC TEST ROUTINES

### 2-6. GENERAL

a. The 10 diagnostic test routines given in paragraphs 2-7 thru 2-16 are applicable for both rocket and cannon applications. In most cases the routines are similar, however, the programs differ since the memory locations are not identical. The repetitive (para 2-16), hot storage (para 2-14), and mechanical reader (para 2-15) tests vary with the program; therefore, it is necessary to use the correct routine for proper series program tape. In the above three tests, the latest issue program tapes must be used since they alter the program due to the difference in memory locations. The cannon and rocket routines used for hot storage differ for this reason.

b. In the nixie test (para 2-11), later programs have a provision for program test 3. The routine is displayed during this test. Cannon programs (starting with part number 8213330-51 thru 821330-56 and later) have provisions for program test 3.

## 2-7. CLEAR MEMORY TEST ROUTINE

a. General Program Description.

(1) Function of test routine is to:

(a) Clear unclassified data from memory.

(b) Zero the memory.

(c) Write a selected pattern into memory.

(2) Use the routine:

(a) After using test tapes B, C, D, and E.

(b) Before loading program.

(c) After diagnostic test tapes.

(3) Use of the clear routine is a must. The FALT controls the FADAC while test tapes B, C, D, and E are running. This checks the memory by writing information in without regard to parity. The information can cause a parity error later, when a program is loaded and run. It is good practice to run the clear routine after the diagnostic tapes and before loading a program, thereby placing the computer in control of all memory locations.

(4) In the clear or zero modes, the test routine memory locations are cleared or zeroed along with the rest of the memory. To repeat either test, the routine must be reloaded. In the pattern writing mode, the test routine remains in storage and the pattern can be repeated or changed indefinitely without reloading the tape.

(5) The routine is stored in memory channel 000.

b. Function Definitions.

(1) A cleared memory has a zero parity bit (TP time) in all words. The zero parity bit clears any extraneous signals in the timing bit positions.

(2) A zeroed memory has zeros written into all memory locations. Since the computer uses odd parity, the parity bit will be a 1.

(3) The keyboard permits writing a selected pattern into memory location 004 and 336. The program is stored and retained in channels 000 and 002.

c. Test Procedures. The test procedures for clearing the memory, zeroing the memory, and pattern writing are as follows:

CLEAR MEMORY

1 Depress program selection button 1 on matrix.

2 Load and verify the tape.

3 Depress PROG TEST button.

4 Set the COMPUTE switch on the SDR to the RUN position. The COMPUTE indicator lights for approximately 5 seconds and the nixie display reads: 00000800000000800

NOTE

At this time the complete memory is cleared. Depressing any of the command pushbuttons causes the machine to hang up in the compute mode.

ZERO MEMORY

1 Depress program selection button 1 on matrix.

2 Load and verify the tape.

3 Depress SM key on keyboard.

4 Set COMPUTE switch on SDR to RUN position. The COMPUTE indicator lights for approximately 5 seconds and the nixie display reads: 00000000000000000

NOTE

At this time the complete memory is zeroed. Depressing any of the command pushbuttons causes the machine to hang up in the compute mode.

PATTERN WRITING

1 Depress program selection button 2.

2 Load and verify the tape.

3 Depress the SET UP button.

4 Set the COMPUTE switch on the SDR to the RUN position. At this time, the IN-OUT indicator lights.

5 Use the keyboard to type in either of the following:

   a. Any number from 0 to 7 inclusive, 11 digits total.

   b. A pattern of alternate numbers from 0 to 7 inclusive (i.e. 2-5, 5-2, 4-7, 7-4, etc, 11 digits total). Each pattern counts as two inputs.

6 Depress key 9 on the keyboard. At this time, the COMPUTE indicator lights for approximately 5 seconds and the nixie display indicates the pattern written into memory. Table 2-1 lists the nixie displays for a variety of patterns.

7 To change or repeat the pattern, depress the SET UP button and repeat steps 5 and 6.

NOTE

The program selection button 1 must be used for clear and zero functions and program selection button 2 is used for pattern writing when entering routines through the SDR. If not, the machine hangs up in the compute mode. When entering the routine the original procedure can be used, or program selection button 2 can be used for all three functions. The routine will then be stored for continual use to clear and zero or write patterns without being reloaded. When this method is used, the channels containing the routine cannot be cleared or zeroed.

2-8. CLEAR MEMORY ROUTINE FOR ALL DATA

This routine conforms to the security requirements (AR 18-7) and must be used when clearing classified data from the memory of the FADAC. The program is in two sections.

   a. The first section enters random numbers into all locations of the memory three times.

   b. The second section clears the entire memory to zero.

ENTERING RANDOM NUMBERS

1 Refer to page 2-4 for loading the tape. When the FILL-VERIFY switch is depressed the tape will run part way through, this enters the random number section of the routine, then halts the tape.

2 Depress RECEIVE button then set the COMPUTE switch on the SDR to RUN position.

3 Depress the SET UP button; the nixie display will show random numbers which are being written into memory.

4 Depress the RESET button, the nixie display will halt on a random number display.

5 Depress the COMPUTE button and display will be reactivated. After a period of 4 minutes and 20 seconds, during which three complete sets of random numbers are written into every location of memory, the display will halt and indicate 00000003.

Table 2-1. Nixie Display Patterns

| Pattern | Sign* | Charge | Nixie display | | | |
|---|---|---|---|---|---|---|
| 0's | | 0 | 000 | 0000 | 0000 | 0000 |
| 1's | | 9 | 492 | 4924 | 9492 | 4924 |
| 2's | | 2 | 924 | 9249 | 2924 | 9249 |
| 3's | - | -- | --6 | --6- | ---6 | --6- |
| 4's | | 4 | 249 | 2492 | 4249 | 2492 |
| 5's | | -- | 6-- | 6--6 | -6-- | 6--6 |
| 6's | | 6 | -6- | -6-- | 6-6- | -6-- |
| 7's | | -- | --- | ---- | ---- | ---- |
| 2-5 | + | -- | --- | ---- | ---- | ---- |
| 5-2 | | 5 | 555 | 5555 | 5555 | 5555 |
| 4-7 | | . | 3.- | 3.-3 | .3.- | 3.-3 |
| 7-4 | | 7 | -79 | -79- | 7-79 | -79- |

*Symbol (-) indicates blank nixie.

TO CLEAR MEMORY

1 Set the COMPUTE switch on SDR to HALT position.

2 Depress the RESET button on FADAC, then depress FILL-VERIFY switch on SDR and remainder of tape will pass through photoreader.

3 Depress the RECEIVE button on FADAC.

4 Depress the RESET button on FADAC.

5 Set the COMPUTE switch on SDR to RUN position. All zeroes will be entered into the memory, and displayed by the nixies. The FADAC memory is now cleared and unclassified.

## 2-9. MEMORY EVALUATION TEST ROUTINE

a. General Description of Program. This test routine performs a dynamic test of the write, read, and associated circuitry used in the input and output of information from the disk memory of the FADAC. The test routine is stored in channels 000 and 002 of the FADAC memory. Channel 000 stores the basic routine and channel 002 stores the error display portion of the routine. The test is accomplished by writing two selected patterns into each channel of memory, then comparing that which was written to that which was read. If the pattern is read incorrectly or doesn't compare correctly, a parity error will halt the routine. It is then possible to display the pattern that was written and the channel and sector of memory involved in the error. The routine automatically uses two 2-5 patterns for this test; however, any other pattern may be selected.

TEST PROCEDURE

1 Depress program selection button 1 on the FADAC control panel.

2 Load and verify the test tape into FADAC using the SDR or mechanical reader. Refer to page 2-4 for procedure.

3 Depress the RESET button and then the PROG TEST button on the FADAC control panel.

4 Set the COMPUTE switch on the SDR to the RUN position. The FADAC nixie display should be as follows:

0 00000 00000 00067

5 Depress the SM key on the computer keyboard. The test will begin with the nixies displaying the following twice for each channel tested:

0 00000 00100 00000

TEST PROCEDURE - CONTINUED

Channels 004 thru 336 will be automatically tested. If no errors occur, the display will halt in approximately 47 seconds displaying the following:

0 00000 00100 00000

b. Auxiliary Operating Instructions.

(1) If it is desired to determine which of the two patterns is being written at any given time, depress the RESET button followed by the PROG TEST button on the FADAC control panel. This will cause a display of 11 digits, which is indicative of the pattern being written. Also, the five nixie tubes on the right-hand side of the display will indicate the last channel and sector of memory tested.

(2) If it is desired to change the two patterns being used for the test, perform the following procedural steps.

PROCEDURE FOR CHANGING THE TWO PATTERNS

1 Depress the RESET button then the SET UP button on the FADAC control panel. The KEYBOARD and the IN-OUT indicators will light.

2 Key in on the keyboard any number between 0 and 7, 11 consecutive times, the first pattern desired for use in the test; followed by depressing the ENTER key on the keyboard. Enter another 11-digit number consisting of 0 thru 7 inclusive, of the second pattern desired for use in the test; followed by depressing the ENTER key on the keyboard.

3 Depress the RESET button followed by the PROG TEST button on the FADAC.

4 Depress the SM key on the keyboard; the nixies will indicate the beginning of the memory evaluation test, this time using the two new patterns that have been entered.

(3) If an error or parity error should occur during testing and it is desired to bypass that channel having the error, proceed as follows:

BYPASS CHANNEL PROCEDURE

1 Depress the RESET button.

2 Depress the TRIG button.

NOTE

The memory evaluation testing will start with the next channel following the channel having the error.

(4) If after an error or parity error has been detected and it is desired to restart the testing in the channel that failed, proceed as follows:

CHANNEL TESTING PROCEDURE

1 Depress the RESET button.

2 Depress the COMPUTE button.

NOTE

This will allow the testing to resume in the channel having the error, which was the last channel tested.

(5) If it is desired to continuously test one specific channel, proceed as follows:

TESTING SPECIFIC CHANNEL PROCEDURE

1 Depress the RESET button.

2 Depress the SEND button. This will cause the KEYBOARD and IN-OUT indicators to light.

3 Depress the keys of the keyboard that correspond to the three-digit number of the channel to be continuously tested.

4 Depress key 9 on the keyboard. The COMPUTE indicator will light and the KEYBOARD and IN-OUT indicators will go out.

NOTE

There will be no display in the nixie tubes, however, the channel designated will be continuously tested until halted by the RESET button.

TESTING SPECIFIC CHANNEL PROCEDURE - CONTINUED

5 To restart the complete memory evaluation, depress the PROG TEST button for a display, then the SM key on the keyboard to start the test.

(6) If it is desired to start testing at some given channel, proceed as follows:

TESTING A GIVEN CHANNEL PROCEDURE

1 Depress the RESET button.

2 Depress the RECEIVE button. This will cause the KEYBOARD and IN-OUT indicators to light.

3 Enter the three-digit number on the keyboard which corresponds to the channel it is desired to start testing.

4 Depress key 9 on the keyboard.

NOTE

The COMPUTE indicator will light with no nixie display; testing will begin at the channel designated and continue until channel 336 is tested.

ERROR PROCEDURE

1 If the nixie display stops with the PARITY indicator flashing, perform the following:

a. Depress the RESET button.

b. Depress the RECALL key on the keyboard.

NOTE

This procedure will cause a display of the information read from main memory along with the channel and sector of memory which caused the parity error.

2 If the RESET step results in the PARITY indicator flashing on the FADAC control panel, depress program selection button 2, RESET button, and then the RECALL key on the FADAC control panel. This will cause the display of the information read from main memory to be read from a loop where there is no parity check. The display will indicate the information read as well as the channel and the sector of memory causing the parity error. Refer to TM 9-1220-221-34/1 for board and pins associated with channel displayed in nixies.

3 After the completion of steps 1 and 2, it is desirable to know which pattern was being written. This may be accomplished by depressing the RESET button and then PROG TEST button on the FADAC control panel. This procedure causes a display indicating the pattern being written into memory during the testing of the memory as well as the last channel tested; pattern written is 11 digits and last channel is 5 digits.

4 If the nixie display stops with the ERROR indicator flashing on the FADAC control panel, this indicates an overflow error. Depress the RESET button on the FADAC front panel. With program selection button 1 already depressed, depress the RECALL button on the FADAC front panel. This will cause a display of the information read from main memory along with the channel and sector involved. Refer to TM 9-1220-221-34/1 for board and pins associated with channel displayed in nixies.

5 If, upon depressing the RECALL button in step 4 above the ERROR or PARITY indicator flashes, depress RESET button and program selection button 2. Then again depress the RECALL button on the FADAC control panel. This will cause a display of the incorrectly read information from a loop where parity is not checked, along with the channel and sector involved.

6 If during the memory evaluation testing, the nixies stop and display channel and sector information, this should be interpreted as a comparison error between what should have been written and what should have been read. With program selection button 1 already depressed, depress the RESET button on the FADAC control panel and then the RECALL key on the FADAC keyboard. This will cause a display in the nixie tubes of the information that is being read from main memory as well as the channel and sector involved. Depress the RESET button and then the PROG TEST button on the FADAC control panel. This will cause a display in the nixie tubes of the information

ERROR PROCEDURE - CONTINUED

that is being written into main memory along with the channel and sector having the comparison error. Refer to TM 9-1220-221-34/1 for troubleshooting the read and write circuits for any given channel.

7 If step 6 above causes an error or parity error, depress program selection button 2, depress RESET button, and then RECALL button. This will cause a display in the nixie tubes of the information read and the channel and sector involved. Depress the PROG TEST button to display the information written, as well as the channel and sector having the error.

(7) Should an error, parity error, or a comparison error occur and FALT tapes cannot locate a defective board or component, replace the circuit boards associated with the channel indicated as defective in the readout in the display panel. Replace the following boards in the channel order listed below.

(a) Read switch boards for channels:

| | |
|---|---|
| 303 | 0 thru 12 inclusive |
| 304 | 14 thru 26 inclusive |
| 305 | 30 thru 42 inclusive |
| 306 | 44 thru 56 inclusive |
| 307 | 60 thru 72 inclusive |
| 308 | 74 thru 106 inclusive |
| 309 | 110 thru 122 inclusive |
| 310 | 124 thru 136 inclusive |
| 311 | 300 thru 312 inclusive |
| 312 | 314 thru 326 inclusive |
| 313 | 330 thru 336 inclusive |

(b) Read amplifier boards 301 and 302.

(c) Network C board 323.

(d) Write switch boards 433 and 434.

(e) Write amplifier boards 435, 436, and 438.

2-10. LOOP (REGISTER) TEST ROUTINE

a. General Description of Program.

(1) The A, L, N, R, and Q loops are separately checked by a constantly changing sequential binary count. Each binary count is checked for correctness by storing the previous count in another memory location and then subtracting the contents of the register which hold this count from the stored count. If all zeros result, the binary count is incremented by one and the process repeats itself. If a nonzero results from the subtraction, computation halts, the NO SOLUTION indicator on the FADAC front panel flashes, and the pattern that caused the alteration is displayed in binary coded decimal (BCD) format in the display readout panel. Register D.0 and D.1 nixie will display the same pattern. The display in the readout panel will continuously increment the count displayed; however, since the registers are counting in a straight binary format and the nixies are displaying the BCD format, certain binary counts cause either plus (+), minus (-), zero (0), or a blank to appear in the affected nixie tube. A general idea can be had on how many times the test had run by reading the most significant digit of the counter prior to blanking. A modified loop test routine displays loop under test (refer to chapter 3).

(2) The two words (D.0 and D.1) in the D loop are checked by a 5-2 pattern which is constantly being subtracted from a stored 5-2 pattern and checked for a zero difference. The computer will remain in a compute mode and a static display of all 5's will appear in the readout panel. An error will cause the NO SOLUTION indicator to flash and computation to halt.

(3) The A register is utilized in all of the loop tests since some registers cannot be loaded directly; therefore, the A register should be suspected if any malfunction occurs during any of these tests. If a malfunction occurs, test the FADAC using the FALT.

TEST PROCEDURE

1 Load tape into FADAC using either the SDR or mechanical reader.

2 After verification, set the COMPUTE switch on the SDR to RUN position.

3 The A register will activate with a counting display in the readout panel.

4 To halt the test, depress RESET switch on the FADAC.

5 To reactivate any one test, depress the following switches for its associated test:

a. SM (sample matrix) for A register test.

b. PROG TEST for L register test.

c. SET UP for N register test.

d. RECALL for R loop test.

e. SEND for Q loop test.

f. COMPUTE for D loop test.

NOTE
In this test a static display of 5's will appear and the FADAC will remain in the COMPUTE mode.

6 The TRIG or RECEIVE button will activate a flashing NO SOLUTION indicator.

ERROR PROCEDURE

1 If a parity error occurs in any of these tests, an incorrect readout of data stored temporarily in main memory, by the program, has occurred. There are no parity checks on the loops or registers themselves. If FALT tapes fail to locate a defective board/component, replace the following boards in order listed:

a. Read amplifier boards 301 and 302.

b. Read switch board 307.

c. Flip-flop boards 210 and 341.

2 If computation halts and the NO SOLUTION indicator flashes, replace the following boards in the order listed for the registers affected:

a. All Registers. All of the registers and loops can be affected by the following:

(1) Flip-flop boards 208 and 317; unit amplifier 438; and read switch 312.

(2) Flip-flop board 316, read switch 304, flip-flop 206, and write amplifier 436.

(3) Flip-flop board 216 and write amplifiers 437 and 438.

(4) Flip-flop boards 239 and 320; write amplifier 438; read switch 313; and flip-flop 315.

b. A Register. Flip-flop boards 239 and 320; write amplifier 438; read switch 313; and flip-flop 315.

c. L Register. Flip-flop boards 218 and 239; write amplifier 435; read switch 311; and flip-flop 217.

d. N Register. Flip-flop board 327; write amplifier 436; read switch 310; and flip-flop 327.

e. R Loop. Flip-flop board 326; write amplifier 437; read switch 307 and 306; and flip-flop 329.

f. Q Loop. Flip-flop board 331; write amplifier 439; read switch 309 and 308; and flip-flop 334.

g. D Loop. Flip-flop board 212; write amplifier 435; read switch 305, and flip-flop 216.

## 2-11. NIXIE DISPLAY TEST ROUTINE

a. General Program Description.

(1) The nixie display routine dynamically checks all nixie tubes in the readout panel to ensure that all the symbols inside the tube light up and the associated circuitry is working. It can be loaded through either the SDR or mechanical reader.

(2) The routine stores coded words for all the symbols inside a nixie in memory. Each time the test cycles, a coded word for a different symbols is brought out of memory and stored in the display register. Each symbol inside the nixie tube lights as the proper code is shifted from memory to the display register.

TEST PROCEDURE

1 Load and verify the tape routine using the procedure on pages 2-4 and 2-5.

2 Set COMPUTE switch on SDR to the RUN position.

3 The nixie readout will automatically provide the following display:

NOTE

Testing starts automatically. Each character will then appear sequentially on the readout nixies.

a. The BATTERY nixie will indicate a static display of the battery button selected.

b. The SIGN nixie will, after a normal nine count, display plus sign (+) and then minus sign (-).

c. With the exception of the battery and sign nixie positions, all remaining nixies will automatically count from zero thru nine, including decimal points.

4 To halt the display, depress the RESET button.

5 To resume the display, depress any of the set up buttons.

b. Error Procedure. Any problem dealing with the nixie readout panel, such as missing numbers, superimposed numbers, intermittent or slow energizing of nixie elements may be isolated, using this tape routine.

ERROR PROCEDURE

1 If the tape can be entered and verified it must be assumed that the D and DA flip-flops are good.

2 For a quick check, replace network B boards 406, 407, 408, and 409, one at a time.

3 If the above does not correct the condition, a FALT E tape should be run to check all the flip-flops and logic gates involved in nixie display.

4 Refer to TM 9-1220-221-34/1 for the theory, logic, and circuitry involved in the display of the readout panel.

## 2-12. CONTROL PANEL TEST ROUTINE

a. General Description of Routine. This routine is used to perform a dynamic check of the switch matrix unit, keyboard unit, and set up buttons of the FADAC control panel. The tape routine consists of three separate sections that can be entered one at a time or for the test of any specific unit.

b. Switch Matrix. This section of the routine samples the eight horizontal and eight vertical pushbuttons as well as the two program selection and five battery selection buttons. A code word corresponding to the switch selection will then be displayed in the readout panel.

c. Keyboard. This section of the routine samples the operation of all the keys of the keyboard with the exception of the SM and RECALL keys which are only physically located on the keyboard. When any one key is depressed, data is generated on information lines (I lines) the routine samples this data and determines which of the 15 keys was pressed. A corresponding code word is selected and is displayed in the readout panel.

d. Set Up Buttons. This part of the routine checks the operation of the eight set up buttons located on the FADAC control panel. Depressing any one of the eight buttons causes the computer to go to a particular location in channel 000 for execution of the first instruction of a routine. The routine then selects a corresponding code word and is displayed in the readout panel.

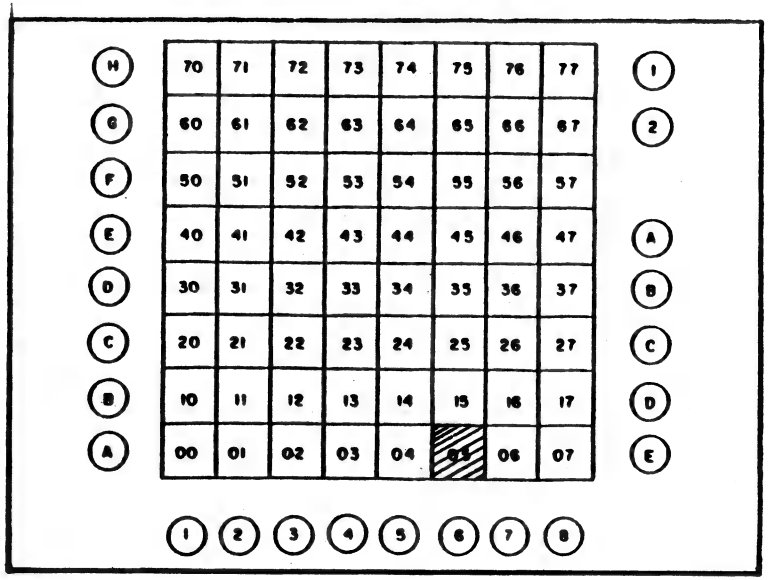
TEST PROCEDURE MATRIX UNIT

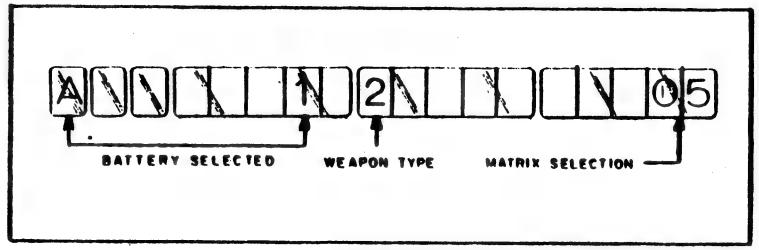
1 Load the tape routine using the procedure on pages 2-4 and 2-5. This tape will automatically go into the verify condition as indicated by the VERIFY indicator. At conclusion of tape section, set COMPUTE switch on SDR to RUN position.

2 To obtain a display of the matrix buttons selected, the SM key must be depressed for each test.

3 The battery button selected (A thru E) will be displayed with a corresponding number 1 thru 5.

4 Program selection will display either a 1 or 2.




5 The two-digit numbers displayed on the extreme right nixies shown in the illustration on page 2-14 will indicate the selection of a horizontal and vertical button. Vertical buttons (A thru H (p 2-14)) are displayed as numbers 0 thru 7, whereas the horizontal buttons (1 thru 8) are also octal numbered 0 thru 7. Thus, if matrix buttons A and 1 were selected, depressing the SM key, would display 0-0, likewise, matrix buttons H and 8 would display 7-7.

6 As each of the matrix positions are selected, ensure that the corresponding matrix window is illuminated.

ERROR PROCEDURE

1 If a parity error occurs, and FALT tapes do not locate a defective board/component, replace the following boards in order listed:

a. Read amplifier boards 301 and 302.

b. Read switch boards 307 and 308.

c. Flip-flop boards 311, 313, 320, and 239.

d. Flip-flop boards 341 and 210.

ERROR PROCEDURE - CONTINUED

2 If the NO SOLUTION indicator flashes or the incorrect data is displayed, ensure that two buttons are fully depressed on the switch matrix (vertical and horizontal rows - 1 each) and that a battery selector button is fully depressed. If the NO SOLUTION indicator flashes after this check and after depressing the SM key again, replace the following boards/components in order listed:

   a. Switch matrix.

   b. Flip-flop board 227, network A boards 402 and 404.

   c. Flip-flop boards 207, 208, and 228.

   d. Network A boards 401, 403, and 405; network B boards 406, 407, 408, and 409.

3 Since only one F line (F-8) carries the weapon data (weapon 1 or 2) an error on this function cannot be indicated except for nonchanging display when either program selection button is depressed. If this occurs, replace the following in order listed:

   a. Switch matrix.

   b. Flip-flop board 207 and network B 407.

KEYBOARD TEST PROCEDURE

1 Place COMPUTE switch on SDR to HALT position.

2 Load keyboard section of tape and place COMPUTE switch on SDR to RUN.

3 Depress COMPUTE button on FADAC to obtain a keyboard control.

4 Depress any number key on keyboard and a corresponding number will be displayed across nixies. The polarity and decimal key, when depressed, will set up a corresponding display.

5 Error Procedure (keyboard test). If a parity error or display error occurs, and FALT tapes do not locate a defective board/ component, replace the following in order as listed:

   a. Keyboard.

   b. Read amplifier boards 301 and 302.

   c. Flip-flop boards 316, 314, 320, 223, 224, 235, 240, and 212.

   d. Network B boards 406, 407, 408, and 409.

   e. Flip-flop boards 315, 226, 233, 239, and 209.

SET UP BUTTONS TEST PROCEDURE

1 Place COMPUTE switch on SDR to HALT position.

2 Load set up portion of test routine and place COMPUTE switch on SDR to RUN position.

   a. All zeros will appear across the nixie display.

   b. Upon depressing any one of the set up buttons, the numbers indicated below will be displayed on the nixie corresponding to the set up button depressed as shown in table 2-2.

Table 2-2. Nixie Display During Set Up Tests

| Set up button | Nixie Readout |
|---|---|
| SM | 0's |
| PROG TEST | 1's |
| SET UP | 2's |
| RECALL | 3's |
| SEND | 4's |
| COMPUTE | 5's |
| TRIG | 6's |
| RECEIVE | 7's |

SET UP BUTTONS TEST PROCEDURE - CONTINUED

c. Error Procedure (Set Up Buttons). If a parity or display error occurs, and FALT tapes do not locate a defective board/component, replace the following in order listed:

(1) Read amplifier boards 301 and 302.

(2) Read switch board 303.

(3) Read switch boards 311 and 313, flip-flop boards 320 and 239.

(4) Flip-flop boards 341 and 210.

2-13. TELETYPE (TT) TEST ROUTINE

a. General Description of Program. This routine is used to perform a dynamic check of the teletype circuit and output capability of the FADAC. All ALPHA characters (letters), numeric characters (numbers), and figures (punctuation) in the teletypewriter are checked as per the following line:

(123456789.&$-/:?) THE QUICK BROWN DOG
JUMPS OVER THE LAZY RED FOX!

PRELIMINARY SETUP PROCEDURE

1 To obtain an output from the FADAC connect a cable or two suitable length wires from J10 connector pins X (term ØPL1) and AA (GROUND) to the teletype input terminals.

2 Connect power cable of teletype unit to a 400-Hz power source.

3 Ensure the input terminal block of the teletype unit has proper strapping connections to accept information from the FADAC. Refer to TM 9-1220-221-34/1.

b. Teletypewriter TT-537 or Equivalent. If the MITE teletype unit is used with the FADAC, connect in the following manner.

TELETYPEWRITER TEST ROUTINE

1 Connect teletype signal cable from rear of teletype unit to the output connector J10 of the FADAC.

2 Three color-coded wires located at the terminal adapter of the cable must be connected as follows:

a. Insert white wire into white terminal marked GND.

b. Insert black wire into black terminal.

c. Insert red wire into red terminal marked REC.

d. Connect a jumper wire (SHORT) across the two black terminals marked SEND.

3 Ensure strapping inside-rear of teletype is connected as follows: 1-2, 3-4, and 5-6.

4 Connect power cable to 400-Hz power source.

5 Turn on teletypewriter.

TEST PROCEDURE

1 Load and verify the test routine using the procedure on pages 2-4 and 2-5.

2 Set the COMPUTE switch on the SDR to the RUN position.

3 The teletypewriter will continuously print out information as per line given in paragraph a. This line of information will continue to be printed out until halted by depressing the RESET button on the FADAC control panel.

4 To reactivate the teletype printout, perform the following:

a. Set the COMPUTE switch on SDR to HALT position.

b. Depress the RESET button on control panel.

c. Depress the RECEIVE button.

d. Depress the START FADAC button on the SDR. This should cause the KEYBOARD and IN-OUT indicators to light on the FADAC control panel.

e. Key in 07300.9 on the keyboard. The KEYBOARD and IN-OUT indicators should go out.

TEST PROCEDURE - CONTINUED

f. Set the COMPUTE switch on the SDR to the RUN position. The teletypewriter should continuously print out the information line.

ERROR PROCEDURE FOR TELETYPEWRITER

1 If the teletypewriter does not print properly, the information given in subparagraph a of these instructions, and FALT test tapes B, C, D, and E have been run successfully without error, then replacement of board 323 (network C) in the FADAC and/or replacement of the teletypewriter cables and junction box and/or replacement of the teletypewriter is indicated.

2 If the teletypewriter does not print, the information given in subparagraph a of these instructions and FALT test tapes B, C, D, and E have not been run, replacement of board 323 (network C), and/or 206 (flip-flop) and/or 335 (flip-flop) and/or 403 (network A) in the FADAC and/or replacement of the teletypewriter cables and junction box and/or replacement of the teletypewriter is indicated.

2-14. CLEAR HOT STORAGE (CANNON/ROCKET)

a. General Program Description.

(1) The clear hot storage (cannon) routine is only used for cannon programs; only one type (8213315-46) is used with the rocket program.

NOTE

This test routine varies with the program and none are identical; therefore, it is necessary to use the correct routine for the proper series program tape.

(2) After loading a cannon or rocket program or the occurrence of a power failure which may generate transients in the computer, program tests 1 and 2 are conducted. Program test 2 checks the working or hot storage, channels 70 thru 76, 110 thru 116 and 130 thru 136. After a successful test, the nixies read 136. After an unsuccessful test, the PARITY indicator flashes and the nixies read the channel in error. The fire mission cannot be completed if the information in that channel is necessary to the computations.

(3) The tape is divided into 12 sections, each section peculiar to one of the 12 hot storage channels. Each section contains the same information as the gun program tape for that channel, but not the information entered through the matrix by the operator.

(4) After running the clear hot storage routine, any information previously entered through the matrix must be reentered. The cannon information stored in the 12 channels of hot storage is shown on the cannon memory map in table 2-3 and the rocket memory map in table 2-4. If one or more channels are cleared, the information indicated on the map for that channel must be reentered if it is necessary to the computations. For example, if channel 130 shows a parity error during a program 2 test and E battery is not required for the fire mission, then the program can be run for the mission and channel 130 cleared later.

b. Description of Tape. At the beginning of each section of tape, the channel number and an arrow are stenciled with the arrow pointing toward the information pertaining to that channel. The tape loads through the mechanical reader and only one section is read at a time. The channel number on the tape section must agree with the nixie display. When activated, the FADAC will accept only the proper section of tape as designated by the keyboard input.

TEST PROCEDURE

1 Load tape in the mechanical reader.

a. Make sure the channel number on the tape agrees with the channel number in the nixie display.

b. Load the tape with the white arrow pointing toward the information to be entered.

2 Depress the associated buttons on the matrix; the CLEAR MEMORY square will light.

3 Depress SM key; the KEYBOARD indicator will come on.

TEST PROCEDURE - CONTINUED

4 Type in the three-digit channel number; the reader activates and the tape section is read. This clears the channel and eliminates the parity error. The information entered by the tape is the same as that on the gun program tape for that channel.

NOTE

Any information entered by the operator for the fire mission, such as battery and target information, must be reentered. See cannon program memory map, (table 2-3) and rocket program memory map (table 2-4).

## 2-15. MECHANICAL READER TEST ROUTINE

a. General Program Description (8213836-98). The tape contains three separate routines and is used to dynamically test the mechanical reader on FADAC. The computer must be loaded with either a cannon or rocket program before this routine can be used. Use of this routine is mandatory prior to replacement of the reader.

NOTE

This test routine varies with the program and none are identical; therefore, it is necessary to use the correct routine for the proper series program tape.

(1) First routine. At a character reading rate of 10 per second, the first routine enters the memory. The computer enters the verify mode and the first routine is repeated. The first routine is being verified. If a character is misread, the reader stops and the ERROR indicator flashes.

(2) Second routine. After a successful first routine the machine automatically goes into the second routine. The character reading rate changes and each character is repeated 10 times to ensure that all acceptable characters are read. If any of these characters are not read correctly, the reader stops and NO SOLUTION indicator flashes.

(3) Third routine. The last routine is a zero routine. The character reading rate returns to 10 per second and the memory locations used during tests are zeroed.

(4) Use. Use of the mechanical reader test routine is mandatory prior to replacement of the reader.

TEST PROCEDURE

1 Put cannon program in the computer.

2 Load tape in the mechanical reader.

3 Depress the matrix buttons H and 8; the CLEAR MEMORY square will light.

4 Depress the SM (sample matrix) key.

a. The IN-OUT indicator will light.

b. The KEYBOARD indicator will light.

5 Type in three zeros (000); the nixies display 000.

6 Depress the ENTER key; the reader activates and testing starts.

Table 2-3. Cannon Program Memory Map

| Information entered | CHANNEL NUMBER 70 | 72 | 74 | 110 | 130 | 76 | 112 | 114 | 116 | 132 | 134 | 136 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | C btry A btry B btry D btry E btry<br>Battery and mission information:<br>1. Set up battery for calibers desired (F-5)*<br>2. Enter battery information (H-1-5)*<br>3. Enter battery nonstandard conditions (G-1-4)*<br>4. Enter target by method formerly used and OT AZ (A-5)*<br>5. Enter mission overrides (B-1-8)*<br>6. Recompute firing data.* | | | | | Enter latitude (F-1)<br>Enter target<br>Enter reg corr data (G-6-8, B-1, 5, 6) | Enter target list (1-88) (E-4) | | | Intersection survey<br>Enter data as designated in survey (D-5), type 2 | Enter observer (1-9)(D-3) | Enter MET message |
| | Enter grid decl angle (F-2) | Enter mass fires (D-8) | | Orientation survey Enter data as designated in survey, type 3 | | | | | | | | |
| | | Traverse survey enter data as designated in survey (D-5), type 1 | | | | | | | | | | |

*These six pieces of information must be entered for each battery used.

Table 2-4. Rocket Program Memory Map

NOTE
Octal base system, only even numbers used.

| Channel number | Working storage locations | | | | |
|---|---|---|---|---|---|
| 70 | Mission A-1 data | Mission A-2 data | Mission B-1 data | Mission B-2 data | |
| 72 | Mission C-1 data | Mission C-2 data | Mission D-1 data | Mission D-2 data | |
| 74 | Mission E-1 data | Mission E-2 data | Observers Lat data | Df | Survey data* |
| 76 | Current meteorological data | | | Decl | Survey data* |
| 110 | Target list | | | Clear | |
| 112 | Firing point list | | Azimuth OL | Clear | |
| 114 | Standard meteorological data dependent on matrix H-7 entry | | | | |
| 116 | Clear | Fuze data* | | Clear | |
| 130 | | Clear | | | |
| 132 | | Clear | | | |
| 134 | | Clear | | | |
| 136 | | Clear | | Azimuth of fire* | QE* |

*Temporary storage, need not be reentered.

b. Rocket Program. With a rocket program in the computer, perform the following.

TEST PROCEDURE

1 Load tape in the mechanical reader.

2 Depress matrix buttons H and 6; the CLEAR MEMORY square will light.

3 Depress the SM (sample matrix) key.

a. The IN-OUT indicator will light.

b. The KEYBOARD indicator will light.

4 Type in 080; the nixies display 080.

5 Depress the ENTER key; the reader activates and testing starts.

c. General Program Description (8213315-116). This routine is to be used with the revision 5 cannon program. The tape tests the sensing accuracy of the mechanical reader by reading 15 different BCD (Binary Coded Decimal) characters, one at a time, and checking each one internally. The characters are 0 thru 9, plus (+), minus (-), decimal (.), CLEAR and ENTER. This type is used in conjunction with the CLEAR MEMORY memory matrix window which is location H-8 on matrix 2. The test continues to completion if no failure occurs through 5 successive groupings of the same 15 characters.

OPERATING PROCEDURE

1 Use the survey-chronograph matrix window with program selection button 2 depressed.

2 Insert the tape into the mechanical tape reader.

3 Depress the matrix buttons H and 8, then the SM key, and the KEYBOARD and IN-OUT indicators will light. Enter three zeros (000) and depress the ENTER key to activate the test.

OPERATING PROCEDURE - CONTINUED

4 If tape runs through to end with no display, the mechanical reader is operational. With a defective mechanical reader, the tape will halt, the NO SOLUTION indicator will light and the FADAC will display three zeros.

2-16. REPETITIVE TEST ROUTINE

a. General Program Description (8213315-34 and 8213836-97).

(1) This routine is designed primarily for direct, general, and depot maintenance use as a confidence check to assist maintenance personnel to assure that the FADAC is operating reliably over an extended period of time, after repairs have been accomplished. The routine may be utilized by direct support units if an intermittent condition is suspected, and providing time is not a factor affecting the unit's workload.

(2) The routine will program the FADAC to perform repetitive gunnery computations of any combination of weapons for which the computer is programmed. The tests included in this procedure may be performed in approximately 12 hours.

NOTE

This test routine varies with the program and none are identical; therefore, it is necessary to use the correct routine for the proper series program tape.

TEST PROCEDURE

1 Load and verify any artillery program (preferably the weapons combination being utilized by the using organization).

2 Load and verify the repetitive test routine and initiate program tests 1 and 2 in accordance with instructions in TM 9-1220-221-10-2 or TM 9-1220-221-10-1.

3 If, during program test 1, the test halts before completion with a parity indication and the proper pattern is not displayed on the nixies, depress the RESET and SEND buttons to display the faulty channel and sectors on the nixies.

4 Enter appropriate sample problems in each battery in accordance with FM-6-3 (series). Sample problem should be computed in both high and low angle missions.

5 Computation of a test problem is initiated by depressing the COMPUTE button. The solution displayed should agree with the solution reflected in the FM.

6 Repetitive computation is initiated by depressing the RECEIVE button:

a. After 15 to 45 seconds, depending on whether a low or high angle problem is computed, the nixies will display the solution then display a count indicating the number of times the solution has been computed.

b. During the repetitive computations routine a malfunction may occur and the computation halts with a parity error indication. Depressing of the RESET and SEND buttons will then cause the number of correct computations to be displayed on the nixies.

c. For a minimum confidence factor, at least 50 solutions should be computed for each battery with the MARGINAL TEST switch in various positions. At least one half of the solutions of each battery should be computed as high angle missions.

NOTE

FADAC must be reprogrammed upon completion of this test.

b. General Program Description (8213315-117). This routine is to be used with the revision 5 cannon program. The tape is used primarily as an aid in determining the repeatability of FADAC. It requires the use of an SDR for loading and thus will be used at higher echelons only. It permits entry of a ballistic problem with completely arbitrary entries and permits repeated problem solution cycles.

OPERATING PROCEDURE

1 After loading any one of the revision 5 cannon weapon tapes, load and verify the repetitive test routine tape into the FADAC via the SDR.

OPERATING PROCEDURE - CONTINUED

2 Execute a program test 1. Display should be as follows: 10909000050000XXX with the three digits on the right indicating the code for the weapon tape.

3 Enter the data necessary for a ballistic computation and depress the COMPUTE button. The solution to the ballistic problem should be displayed as usual. Depression of the RECEIVE button will initiate a series of repeated problem solutions and displays. Each display is a momentary one showing the number of computational cycles completed.

4 If a PARITY or ERROR indication occurs, or if the RESET button is depressed while a test is in process, then depressing the SEND button will cause display of the number of computational cycles completed.

# CHAPTER 3
# OVERALL OPERATION

## 3-1. GENERAL

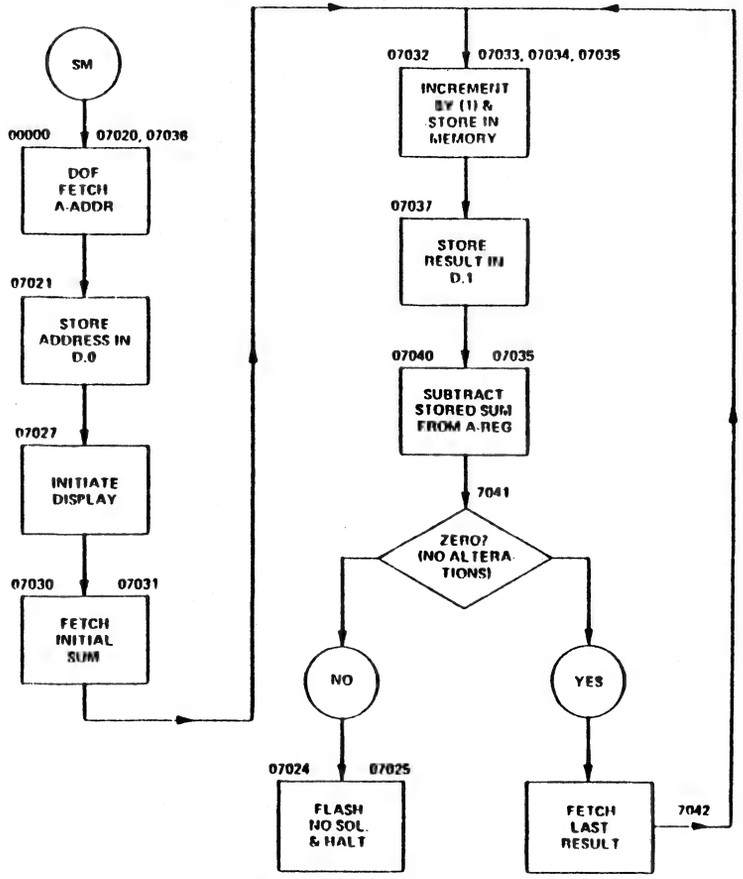
This chapter provides a flow chart, printout, and program instructions. The flow chart shows the loop test configuration for the FADAC. The printout shows the coded data punched on tape for the loop test flow chart. The program instructions provide sufficient information to originate a flow chart and/or program.

## 3-2. FLOW CHART, INITIAL SET UP

The flow chart and printout (p 3-1 and 3-2) is the sequence of the loop test prior to performing the diagnostic routine. The flow chart depicts the basic sequence of events necessary to interpret the test results. The printout would illustrate the data contained on the actual punched tape used when entering information into the memory of the FADAC.

## 3-3. PROGRAMMING INSTRUCTIONS

The programming instructions in the tables following are for general information purposes and instructions for field use. The capability of reading the perforation code of the tapes and knowledge of the computed functions at the place of error may be of value in isolating trouble. The tables show the functional codes and executions for the generation of programs for the FADAC. Tables 3-1 thru 3-8 provide program instructions; tables 3-9 and 3-10 provide addresses for control buttons and the register loops.




FLOW DIAGRAM, LOOP TEST

```
         07024.07025371600   NO SOL
         00000372000         HALT
SM       00000.07020370000   DOF
07027    07027.07030376400   IDM
30       07032247031         FETCH (CLA)
31       00000000000         INITIAL SUM
32       07034007033         ADD
33       00000000000         INCREMENT
34       07037507035         (A)    M (STORAGE)
35       00000000000         SUM STORAGE
36       37705600017         BCD ADDRESS OF A-REG
37       07040516001         (A)    D.1
07040    07040.07041027035   SUB
41       07024127042         TZE
42       07032247035         FETCH
07020    07020.07021247036   FETCH
21       07027516000         (A)    D.0

PROG TEST 00001.07043370000  DOF
07045    07045.07046376400   IDM
46       07047247031         FETCH
47       07050007033         ADD
50       07052507051         (A)    M (STORAGE)
51       00000000000         SUM STORAGE
52       27054257000         (A)    L-REG
53       37705620017         BCD ADDRESS OF L-REG
54       07055516001         (A)    D.1
55       07056037200         SUB
56       07024127057         TZE
07057    07057.07047247051   FETCH
07043    07043.07044247053   FETCH
07044    07045516000         (A)    D.0

SET UP   00002.07060370000   DOF
07062    07062.07063376400   IDM
63       07064247031         FETCH
64       07065007033         ADD
65       27070507066         (A)    M (STORAGE)
66       00000000000         SUM STORAGE
67       37705640017         BCD ADDRESS OF N-REG
70       07071516001         (A)    D.1
71       07072037400         SUB
72       07024127073         TZE
73       07064247066         FETCH
17060    07060.07061247067   FETCH
61       07062516000         (A)    D.0

RECALL   00003.07110370000   DOF
07075    07075.07076376400   IDM
76       07077247031         FETCH
77       07100007033         ADD
07100    27101737000         (A)    R.0
101      07104507102         (A)    M (STORAGE)
102      00000000000         SUM STORAGE
103      37705020017         BCD ADDRESS OF R-LOOP
104      07105516001         (A)    D.1
105      07106034200         SUB
106      07024127107         TZE
107      07077247102         FETCH
07110    07110.07111247103   FETCH
111      07075516000         (A)    D.0

SEND     00004.07112370000   DOF
07115    07115.07116376400   IDM
116      07117247031         FETCH
117      07120007033         ADD
07120    07120.07121737000   (A)    Q.0
07121    07121.07124507122   (A)    M (STORAGE)
122      00000000000         SUM STORAGE
123      37705220017         BCD ADDRESS FOR Q-LOOP
124      07125516001         (A)    D.1
125      07126035200         SUB
126      07024127127         TZE
127      07117247122         FETCH
07112    07112.07113247123   FETCH
113      07113.07115516000   (A)    D.0

COMP     00005.07135370000   DOF
07135    07135.07136376400   IDM
136      07140247137         FETCH
137      52525252525         PATTERN
07140    07140.07141516000   (A)    D.0
141      07141.07142516001   (A)    D.1
142      07143036000         SUB
143      07024127144         TZE
144      07145247137         FETCH
145      07146036001         SUB
146      07024127136         TZE

TRIG.    00006.07025371600   NO SOL
REC.     00007.07025371600   NO SOL

         00000.9
```

PRINTOUT FOR LOOP TEST FLOW CHART

Table 3-1. Programming Instructions, Arithmetic

| Operation | Mnemonic | Code | Flag | Execution |
|---|---|---|---|---|
| Add | Add | 00 | 1/0 | Add contents of some location in M to contents of A. Sum stored in A. Flag of 1, replace N with M; flag of 0, N remains unaltered. Overflow can occur. One word time of execute. |
| Subtract | Sub | 02 | 1/0 | Subtract contents of some location in M from contents of A; difference stored in A. Flag of 1, replace N with M; flag of 0, N remains unaltered. Overflow can occur. One word time of execute. |
| Multiply | Mpy | 20 | no flag | The contents of some location in M are multiplied by the contents of A. The product is stored in A (sign and 31 most significant bits) and L. Location M is also stored in N. Eighteen word times of execute. |
| Divide | Div | 30 | 1/0 | A 62-bit number in the A and L is divided by the contents of a location in M. Flag of 0, quotient in A is rounded; flag of 1, quotient in A is unrounded and remainder is in L. Work from M is also placed in N. Overflow can occur. Eighteen word times of execute. |
| Clear and add | CLA | 24 | 0/1 | The contents of some location M are transferred to the A. Flag of 1 transfers previous contents of A to L. Flag of 0, L remains unaltered. One word time of execute. |
| Clear and subtract | CLS | 26 | 0/1 | The negative (2's complement) of the contents of some location M are transferred to the A. Flag of 1 transfers previous contents of A to L. Flag of 0, L remains unaltered. One word time of execute. |

Table 3-2. Programming Instructions, Store and Load

| Operation | Mnemonic | Code | Flag | Execution |
|---|---|---|---|---|
| Store N | STN | 40 | no flag | The contents of the N are stored in some addressable location in M. |
| Store D | STO | 42 | 0/1 | The contents of sector i of the two-word D loop are stored in location M where i=100 if M is even, and i=001 if M is odd. Flag of 1 store in N; flag of 0, N remains unaltered. One word time of execute. |
| Store A | STA | 50 | 0/1 | The contents of A are stored in location M. Flag of 1 store in N also; flag of 0, N remains unaltered. One word time of execute. |
| Store L | STL | 52 | 0/1 | The contents of L are stored in location M. Flag of 1 store in N also; flag of 0, N remains unaltered. One word time of execute. |
| Store Operand Address | STD formerly (STA) | 70 | no flag | The right address of a word in location M is replaced by the right address of the work in A (13 bits). The modified contents of M are placed in N. Three word times of execute. |
| Store Program (NI) Address | STP | 60 | no flag | The left address of a word in location M is replaced by the left address of the word in A (13 bits). The modified contents of M are placed in N. Three word times of execute. |
| Store R Loop | STR | 62 | no flag | The contents of the 16 words of the R loop are transferred through the D loop to memory at location M. Eighteen word times of execute. |
| Load Q | LDQ | 72 | 0 | The contents of 16 consecutive words of memory starting. |
| Load R | LDR | 72 | 1 | With location M are transferred to one of the rapid access loops. Flag of 1 indicates the R loop; flag of 0 indicates Q loop. Sixteen word times of execute. |

Table 3-3. Programming Instructions, Control Transfer

| Operation | Mnemonic | Code | Flag | Execution |
|---|---|---|---|---|
| Transfer on Plus | TPL | 10 | 0/1 | Control is transferred to the instruction found in location M if the contents of A are greater than or equal to zero. Flag of 1 loads N with instruction; flag of 0, N unaltered. One word time of execute. |
| Transfer on Zero | TZE | 12 | 0/1 | Control is transferred to the instruction found in location M if the contents of the A are equal to zero. Flag of 1 loads N with instruction: flag of 0, N unaltered. One word time of execute. |
| Unconditional Transfer | TRA | 14 | 0/1 | Control is always transferred to the instruction found in location M. Flag of 1, loads N with instruction; flag of 0, N unaltered. One word time of execute. |
| Transfer on Overflow | TOV | 16 | 0/1 | Control is transferred to the instruction found in location M when an overflow has occurred. Flag of 1 loads N with instruction; flag of 0, N unaltered. One word time of execute. |

Table 3-4. Programming Instructions, Shift and Cycle

| Operation | Mnemonic | Code | Flag | Execution |
|---|---|---|---|---|
| Accumulator Right Cycle | ARC | 7600 | | The contents of the A loop are shifted right the number of binary positions designated by S. The bits shifted off the right end of the A enter the left end through the sign position in the same sequence. |
| Accumulator Right Shift | ARS | 7602 | | The contents of the A loop are shifted right the number of binary places designated by S. The bits shifted beyond the right-hand limits of the A are lost. |
| Accumulator Left Cycle | ALC | 7604 | | The contents of the A loop are shifted left through the sign bit position the number of binary places indicated by S. The bits shifted off the left end enter the right end in the same sequence. |
| Accumulator Left Shift | ALS | 7606 | | The contents of the A loop are shifted left through the sign bit the number of binary places indicated by S. Bits shifted beyond the sign position are lost, positions left vacant are filled with zeros. |

Table 3-4. Programming Instructions, Shift and Cycle--Continued

| Operation | Mnemonic | Code | Flag | Execution |
|---|---|---|---|---|
| Long Right Cycle | LRC | 7620 | | The contents of the A and L loops are shifted right the number of binary places indicated by S. The bits shifted off the right end of the A are shifted into the L through the sign position. The bits shifted off the right end of the L are shifted into the A through the sign position. |
| Long Right Shift | LRS | 7622 | | The contents of the A and L loops are shifted right the number of binary places designated by S. The bits shifted off the right end of A are shifted into the L through the sign position. The bits shifted off the L are lost. |
| Long Left Cycle | LLC | 7624 | | The contents of the A and L loops are shifted left the number of binary places indicated by S. The bits shifted left through the sign of A are shifted into the right end of L. Bits shifted through the sign position of the L are shifted into the right end of the A. |
| Long Left Shift | LLS | 7626 | | The contents of A and L loops are shifted left the number of places designated by S. The bits shifted through the sign position of the L are shifted into the right end of the A. Bits shifted beyond the sign of A are lost. The bits of the L vacated in shifting are filled with zeros. |

NOTE

Place the number of bits to be shifted or cycled in the sector portion of the operand address. The channel portion of the operand address is part of the operation code. Flag in all shift and cycle commands indicates computer should test for overflow.

Execution time for shift and cycle commands = $(K/2) + [1/2 + (S+1)]$ where S = number bits shifted and K = 0 when S is odd, and K = 1 when S is even.

Table 3-5. Programming Instructions, Special

| Operation | Mnemonic | Code | Flag | Execution |
|---|---|---|---|---|
| Extract (Logical "and") | EXT (ANA) | 34 | no flag | The contents of A are replaced by the logical "and" of the contents of A and some location M. One word time of execute. |
| Equal Search | EQS | 64 | 0/1 | The contents of A are compared with those in memory location (M+1) in bit positions as indicated by a mask appearing in the L. With agreement and a flag of 1 the contents of A dump into L. If agreement is not reached, the flag has no effect. |
| Greater than or Equal Search | GES | 66 | 0/1 | The contents of A are compared with those in memory location (M+1) in bit positions as indicated by a mask appearing in the L. The comparison is satisfied if all of the bit positions of M, which are compared, are greater than or equal to the corresponding bit positions of A. With agreement and a flag of 1 the contents of A dump into L. If agreement is not reached, the flag has no effect. |
| Halt | HLT | 3720 | no flag | Program computation is halted. The next instruction address is ignored by this command. One word time of execute. |
| Halt COMPUTE Indicator | HCL (HCM) | 3724 | no flag | The COMPUTE indicator will be turned off with the computation mode unaffected. One word time of execute. |
| Initiate COMPUTE Indicator | ICL (ICM) | 3726 | no flag | The COMPUTE indicator will be turned on. Computative mode will be unaffected. One word time of execute. |
| Zero L | ZEL | 3762 | no flag | The L loop is cleared to zero. The flag bit and operand sector are ignored. One word time of execute. |
| Initiate Display Mode | IDM | 3764 | no flag | Visual display is activated until an HDM or input/output command is given. One word time of execute. |
| Halt Display Mode | HDM | 3766 | no flag | Visual display mode halted. |
| Take Absolute Value | ABS | 3770 | 0/1 | The contents of A are replaced by their absolute value; if the contents are negative, they will be replaced by the corresponding positive quantity. Flag of 1 and contents are negative, load the L from A. |
| Replace A on Minus from L | RML | 3772 | | If the contents of A are negative, then the negative of the contents of L or N, respectively, will replace the contents of the A. If the contents of the A are positive, they will be unchanged. If the contents of A are negative, and the flag bit is 1, then this negative quantity is transferred to the L. One word time of execute. |
| Replace A on Minus from N | RMN | 3774 | | |

Table 3-6. Programming Instructions, Serial Input/Output

| Operation | Mnemonic | Code | Flag | Execution |
|---|---|---|---|---|
| Discrete Input to Accumulator | DIA | 3640 | no flag | Information on 32 discrete input lines are input to the A, enabling the program to sample the various signals input to the computer. The main application of this command is for sampling the information from the selection matrix. One word time of execute. |
| Discrete Outputs Off | DOF | 3700 | no flag | This command will reset the three-bit counter to zero, turning off the output lines or the NO SOLUTION indicator. One word time of execute. |
| Output Device Stepping-1 | OD1 | 3702 | no flag | These three commands energize a given pin on the output plug J010. Their use could be to step an output device such as a relay or output information to a two-wire serial teletype machine. It must be realized that once the output lines are energized they will remain so until turned off by the DOF command. Therefore, any timing requirements can only be met under program control. |
| Output Device Stepping-2 | OD2 | 3704 | no flag | |
| Output Device Stepping-3 | OD3 | 3706 | no flag | |
| Input Device Stepping-1 | ID1 | 3710 | no flag | These three commands energize a given pin on the input plug J017. They may be used to step an input device. As with output device stepping commands, timing requirements can only be met under program control. |
| Input Device Stepping-2 | ID2 | 3712 | no flag | |
| Input Device Stepping-3 | ID3 | 3714 | no flag | |
| NO SOLUTION Indicator | NSL | 3716 | no flag | The NSL command turns on the NO SOLUTION indicator on the front panel of FADAC. |

## 3-4. MNEMONIC CODE BREAKDOWN

In table 3-7 on page 3-9 the mnemonic code is broken down into individual elements. This code is used in table 3-8 on page 3-9. For example the first entry in table 3-8 under the Mnemonic column is WEOT. If you look at table 3-7 you will find that the W stands for Write (output), the E stands for External, O stands for Octal, and T stands for Teletype; so WEOT stands for Write (FADAC) to External device in Octal (Teletype). When the Interpretation column is checked in table 3-8, this interpretation is found to be correct according to table 3-7.

## 3-5. PROGRAMMING INSTRUCTIONS

In all parallel I/O commands, a flag indicates input (output) by word, no flag indicates input (output) by character. No operand address is allowed in I/O commands. The bits which normally designate the channel of the operand address are part of the I/O operation code. Bits which normally designate the sector of the operand address are used to designate the characters (words) to be input (output), less one.

Table 3-7. Parallel Input/Output Mnemonic Code Breakdown

| Position | Mnemonic | Code breakdown |
|---|---|---|
| Position 1 | | |
| Function | W | Write (output) |
| | R | Read (input) |
| Position 2 | | |
| Means | E | External device |
| | T | Mechanical reader |
| | K | Keyboard |
| | M | Magnetic tape |
| | F | FADAC |
| Position 3 | | |
| Mode | D | Decimal |
| | O | Octal |
| | 4 | Alpha-4 |
| | 5 | Alpha-5 |
| | 6 | Alpha-6 |
| Position 4 | | |
| Tape code | T | Teletype |
| | F | Field data |

Table 3-8. Programming Instructions, Parallel Input/Output

| Mnemonic | Operation code | Interpretation |
|---|---|---|
| WEOT | 4400 | Write FADAC to external device in octal (TT) |
| WFOT | 4420 | Write FADAC to FADAC in octal (TT) |
| WEOF | 4440 | Write FADAC to external device in octal (FD) |
| WFOF | 4460 | Write FADAC to FADAC in octal (FD) |

Table 3-8. Programming Instructions, Parallel Input/Output--Continued

| Mnemonic | Operation code | Interpretation |
|---|---|---|
| WEDT | 4500 | Write FADAC to external device in decimal (TT) |
| WFDT | 4520 | Write FADAC to FADAC in decimal (TT) |
| WEDF | 4540 | Write FADAC to external device in decimal (FD) |
| WFDF | 4560 | Write FADAC to FADAC in decimal (FD) |
| WE6 | 4600 | Write FADAC to external device in A-6 |
| WF6 | 4620 | Write FADAC to FADAC in A-6 |
| WE5 | 4700 | Write FADAC to external device in A-5 (flag required) |
| WF5 | 4720 | Write FADAC to FADAC in A-5 (flag required) |
| WE4 | 4700 | Write FADAC to external device in A-4 (flag must be omitted) |
| WF4 | 4720 | Write FADAC to FADAC in A-4 (flag must be omitted) |
| REO | 5400 | Read external device in octal |
| RTO | 5420 | Read tape device in octal |
| RKO | 5460 | Read keyboard in octal |
| RED | 5500 | Read external device in decimal |
| RID | 5520 | Read tape device in decimal |
| RKD | 5560 | Read keyboard in decimal |

Table 3-8. Programming Instructions, Parallel Input/Output--Continued

| Mnemonic | Operation code | Interpretation |
|---|---|---|
| RE6 | 5600 | Read external device in A-6 |
| RT6 | 5620 | Read tape device in A-6 |
| RM6 | 5640 | Read magnetic tape in A-6 |
| RK6 | 5660 | Read keyboard in A-6 |
| RE5 | 5700 | Read external device in A-5 |
| RT5 | 5720 | Read tape device in A-5 |
| RM5 | 5740 | Read magnetic tape in A-5 |
| RD5 | 5760 | Read keyboard in A-5 |

Table 3-9. Control Button Addresses

| Control button | Address |
|---|---|
| SM | 00000 |
| PROG TEST | 00001 |
| SET UP | 00002 |
| RECALL | 00003 |
| SEND | 00004 |
| COMPUTE | 00005 |
| TRIG | 00006 |
| RECEIVE | 00007 |

Table 3-10. Register Loop Addresses

| Register Loop | Addresses |
|---|---|
| R | 142. (00 to 17) |
| RM | 140. (00 to 17) |
| Q | 152. (00 to 17) |
| QM | 150. (00 to 17) |
| D | 16000 or 16001 |
| A | 17000 |
| L | 17200 |
| N | 17400 |

# CHAPTER 4
# SHIPMENT AND DESTRUCTION TO PREVENT ENEMY USE

## Section I. SHIPMENT

4-1. DOMESTIC SHIPMENT INSTRUCTIONS

When shipping the diagnostic tapes the officer in charge of preparing shipment will be responsible for materiel being shipped in a serviceable condition and properly processed for shipment, including the preparation of Army shipping documents.

4-2. PREPARATION FOR SHIPMENT

a. Preservation. Preservation and other protective measures taken in the preparation of the materiel and basic issue items for shipment must be sufficient to protect the tapes against deterioration and physical damage during shipment.

b. Packaging.

(1) Place tapes in a snug-fitting, heat-sealable bag fabricated from waterproofed-greaseproof barrier material, (grade A, class 1, type II 8135-00-292-9722 (36 in. width)) and seal to effect closure.

(2) Apply marking to provided identification and destination card holders in accordance with MIL-STD-129E.

## Section II. DESTRUCTION OF MATERIEL TO PREVENT ENEMY USE

4-3. GENERAL

a. Destruction of the diagnostic tapes, when subject to capture or abandonment in the combat zone, will be undertaken by the using arm only when, in the judgment of the unit command concerned, such action is necessary in accordance with orders or policy established by the Army commander.

b. The information that follows is for guidance only. Certain of the procedures outlined require the use of explosives and incendiary grenades that normally may not be authorized items of issue to the using organization. Since the diagnostic tapes are relatively small items, the destruction plans may be incorporated in with overall destruction plans for other materiel, large or small. The issue of these and related materials and the conditions under which destruction will be affected are command decisions in each case, according to the tactical situation. Of the several means of destruction, those most generally applicable are:

| | |
|---|---|
| Mechanical ..... | Requires axe, pick mattock, sledge, crowbar, or similar implement. |
| Burning ..... | Requires gasoline, oil, incendiary grenades, or other flammables, welding or cutting torch. |
| Demolition ..... | Requires suitable explosive or ammunition. |

Gunfire ..... Includes artillery, machine guns, rifles, using rifle grenades, and launchers using antitank rockets. Under some circumstances hand grenades may be used.

Disposal ..... Requires burning in the ground, dumping in streams or marshes, or scattering so widely as to preclude recovery of essential parts.

c. In general, destruction of essential parts followed by burning will usually be sufficient to render the materiel useless. However, selection of the particular method of destruction requires imagination and resourcefulness in the utilization of the facilities at hand under the existing conditions. Time is usually critical.

CAUTION

If destruction by demolition is directed, due consideration should be given to the observance of appropriate safety precautions.

d. If destruction to prevent enemy use is resorted to, the materiel must be so badly damaged that it cannot be restored to a usable condition in the combat zone either by repair or cannibalization.

APPENDIX A

REFERENCES

A-1. TECHNICAL MANUALS (TM)

| | |
|---|---|
| TM 38-750 ..... | The Army maintenance management system (TAMMS) |
| TM 9-1220-221-10-1 ..... | Operator's manual: computer, gun direction, M18 |
| TM 9-1220-221-10-2 ..... | Direct support and general support maintenance manual: computer, gun direction, M18 |
| TM 9-1220-221-20P ..... | Organizational maintenance manual including repair parts and special tools list for computer, gun direction M18 |
| TM 9-1220-221-34/1 ..... | Direct support and general suport maintenance manual: computer, gun |
| TM 9-1220-221-34/1/1 ..... | Direct support and general support maintenance manual: computer gun direction M18 |
| TM 9-1220-221-34/2 ..... | Direct support and general support maintenance manual: computer, gun direction, M18 (test tape B program printout) |
| TM 9-1220-221-34/3 ..... | Direct support and general support maintenance manual: computer, gun direction, M18 (test tape C program printout) |
| TM 9-1220-221-34/4 ..... | Direct support and general support maintenance manual: computer, gun direction, M18 (test tape D program printout) |
| TM 9-1220-221-34/5 ..... | Direct support and general support maintenance manual: computer, gun direction, M18 (test tape E program printout) |
| TM 9-1220-221-34/6 ..... | Direct support and general support maintenance manual: computer, gun direction, M18 (wire list) |
| TM 9-1220-221-34/7 ..... | Direct support and general support maintenance manual: computer, gun direction, M18 (component list) |
| TM 9-1220-221-34P ..... | Direct support and general support maintenance repair parts and special tools list for computer, gun direction, M18 |

A-2. OTHER

| | |
|---|---|
| AR 385-40 ..... | Accident reporting and records. |
| DA Form 2028 ..... | Recommended changes to publications and blank forms. |
| DA PAM 310-2 ..... | Index of blank forms. |
| FM 21-11 ..... | First aid for soldiers. |

# INDEX

By Order of the Secretary of the Army:

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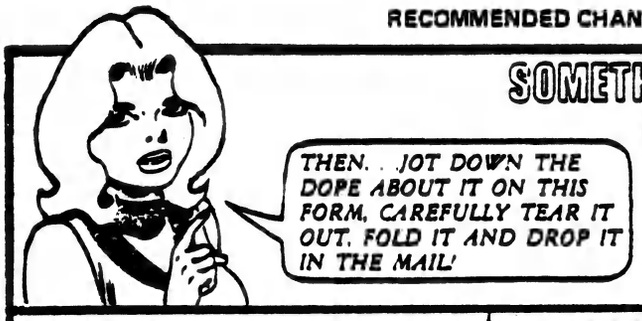


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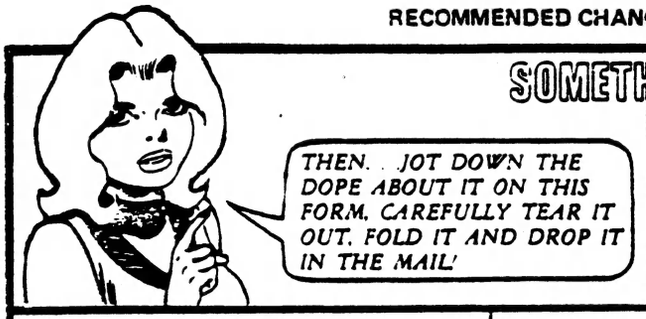


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